

Claims

- [c1] 1. A time-domain communication system for use in an ultrasonic imaging system, the time-domain communication system comprising:
an ultrasonic array having a plurality of ultrasonic array outputs;
a time-domain multiplexer having an input connected to each of the plurality of ultrasonic array outputs and having a multiplexer output, the time-domain multiplexer continually cycles through each of the plurality of ultrasonic array outputs at a predetermined frequency connecting each of the plurality of ultrasonic array outputs to the multiplexer output for a predetermined amount of time wherein the plurality of ultrasonic array outputs comprises a first number of outputs and the multiplexer output comprises a second number of outputs, the first number of outputs being greater than the second number of outputs;
a de-multiplexer having an input connected to the multiplexer output, the de-multiplexer having a plurality of de-multiplexer outputs, the de-multiplexer continually cycles through each of the plurality of de-multiplexer outputs at the predetermined frequency connecting each of the plurality of de-multiplexer outputs to the multiplexer output for the predetermined amount of time wherein the plurality of de-multiplexer outputs comprises a third number of outputs, the third number of outputs being greater than the second number of outputs;
a time gain control amplifier connected to each of the plurality of de-multiplexer outputs and amplifying each respective signal in each of the plurality of de-multiplexer outputs;
an analog to digital converter connected to the time gain control amplifier wherein each respective signal in each of the plurality of de-multiplexer outputs is converted to a digital signal at a sample frequency rate; and
a timing reference connected to the time-domain multiplexer, the de-multiplexer and the analog to digital converter for providing a single timing reference to determine at least the predetermined frequency and the sample frequency rate.

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- [c2] 2. The system of Claim 1 wherein the analog to digital converter is connected to image processing electronics for generating an ultrasonic image.
- [c3] 3. The system of Claim 1 wherein the ultrasonic array comprises a plurality of cables bundles wherein each of the plurality of cable bundles includes at least one ultrasonic array output of the plurality of ultrasonic array outputs.
- [c4] 4. The system of Claim 3 wherein the time-domain multiplexer comprises a plurality of time-domain multiplexers and the de-multiplexer comprising a plurality of de-multiplexers, each of the plurality of time-domain multiplexers having a multiplexer output wherein each of the plurality of time domain multiplexers are connected to a respective one of the plurality of cable bundles and the multiplexer output of each of the plurality of time-domain multiplexer being connected to a respective one of the plurality of de-multiplexers.
- [c5] 5. The system of Claim 1 wherein the predetermined frequency comprises the sample frequency rate times the first number of outputs.
- [c6] 6. A time-domain communication system for use in an ultrasonic imaging system, the communications system comprising:
 - an ultrasonic probe comprising;
 - an ultrasonic array having a plurality of ultrasonic array outputs; and
 - a time-domain multiplexer having an input connected to each of the plurality of ultrasonic array outputs and having a multiplexer output wherein the time-domain multiplexer continually cycles through each of the plurality of ultrasonic array outputs at a predetermined frequency connecting each of the plurality of ultrasonic array outputs to the multiplexer output for a predetermined amount of time;
 - an ultrasonic data processing unit comprising:
 - a de-multiplexer connected to the multiplexer output, the de-multiplexer having a plurality of de-multiplexer outputs wherein the de-multiplexer continually cycles through each of the plurality of de-multiplexer outputs at

- the predetermined frequency connecting each of the plurality of de-multiplexer outputs to the multiplexer output for the predetermined amount of time;
- a timing reference connected to the time-domain multiplexer and the de-multiplexer for providing a single timing reference to determine at least the predetermined frequency.
- [c7] 7. The system of Claim 6 wherein the plurality of ultrasonic array outputs comprises a first number of outputs and the multiplexer output comprises a second number of outputs, the first number of outputs being greater than the second number of outputs.
- [c8] 8. The system of Claim 7 wherein the plurality of de-multiplexer outputs comprises a third number of outputs, the third number of outputs being greater than the second number of outputs.
- [c9] 9. The system of Claim 6 further comprising a time gain control amplifier connected to each of the plurality of de-multiplexer outputs and amplifying each respective signal in each of the plurality of de-multiplexer outputs.
- [c10] 10. The system of Claim 9 further comprising an analog to digital converter connected to the time gain control amplifier and the timing reference wherein each respective signal in each of the plurality of de-multiplexer outputs is converted to a digital signal at a sample frequency rate.
- [c11] 11. The system of Claim 10 wherein the analog to digital converter is connected to image processing electronics for generating an ultrasonic image.
- [c12] 12. The system of Claim 6 wherein the ultrasonic array comprises a plurality of cables bundles wherein each of the plurality of cable bundles includes at least one of the plurality of ultrasonic array outputs.
- [c13] 13. The system of Claim 12 wherein the time-domain multiplexer comprises a plurality of time-domain multiplexers and the de-multiplexer comprising a

plurality of de-multiplexers, each of the plurality of time-domain multiplexers having a multiplexer output wherein each of the plurality of time domain multiplexers are connected to a respective one of the plurality of cable bundles and the multiplexer output of each of the plurality of time-domain multiplexer being connected to a respective one of the plurality of de-multiplexers.

- [c14] 14. A method for time-domain communication in an ultrasonic imaging system, the method comprising the steps of:
acquiring ultrasonic data from an ultrasonic array;
transmitting the ultrasonic data via a plurality ultrasonic array outputs to a time-domain multiplexer having an input connected to each of the plurality of ultrasonic array outputs, the plurality of ultrasonic array outputs comprising a first number of outputs;
continually cycling through each of the plurality of ultrasonic array outputs at a predetermined frequency to connect and transmit the ultrasonic data from the plurality of ultrasonic array outputs to at least one multiplexer output for a predetermined amount of time, the at least one multiplexer output having a second number of outputs wherein the first number of outputs is greater than a second number of outputs;
connecting the at least one multiplexer output to a de-multiplexer having a plurality of de-multiplexer outputs, the plurality of de-multiplexer outputs comprising a third number of outputs wherein the third number of outputs is greater than the second number of outputs;
continually cycling through the plurality of de-multiplexer outputs at the predetermined frequency to connect each of the plurality of de-multiplexer outputs to the at least one multiplexer output and to transmit the ultrasonic data from the multiplexer output to the plurality of de-multiplexer outputs;
amplifying the ultrasonic data in the plurality of de-multiplexer outputs;
converting the ultrasonic data to digital ultrasonic data at a sampling frequency rate; and
creating an ultrasonic image from the digital ultrasonic signal.

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- [c15] 15. The method of Claim 14 wherein the predetermined frequency comprises the sample frequency rate multiplied by the first number of outputs.
- [c16] 16. The method of Claim 14 wherein the predetermined frequency and the sample frequency rate are provided by a timing reference.
- [c17] 17. A method for time-domain communication in an ultrasonic imaging system, the method comprising the steps of:
 - acquiring ultrasonic data from an ultrasonic array;
 - transmitting the ultrasonic data via a plurality ultrasonic array outputs to a time-domain multiplexer having an input connected to each of the plurality of ultrasonic array outputs wherein the plurality of ultrasonic array outputs comprising a first number of outputs;
 - continually cycling through each of the plurality of ultrasonic array outputs at a predetermined frequency to connect and transmit the ultrasonic data from each of the plurality of ultrasonic array outputs to at least one multiplexer output for a predetermined amount of time;
 - connecting the at least one multiplexer output to a de-multiplexer having a plurality of de-multiplexer outputs; and
 - continually cycling through the plurality of de-multiplexer outputs at the predetermined frequency to connect each of the plurality of de-multiplexer outputs to the at least one multiplexer output and to transmit the ultrasonic data from the multiplexer output to the plurality of de-multiplexer outputs.
- [c18] 18. The method of Claim 17 wherein the at least one multiplexer output has a second number of outputs and the first number of outputs being greater a second number of outputs.
- [c19] 19. The method of Claim 18 wherein the plurality of de-multiplexer outputs comprises a third number of outputs and the third number of outputs is greater than the second number of outputs.
- [c20] 20. The method of Claim 17 further comprising the step of amplifying the ultrasonic data output from the plurality of de-multiplexer outputs.

- [c21] 21. The method of Claim 17 further comprising the step of converting the ultrasonic data to digital ultrasonic data at a sampling frequency rate.
- [c22] 22. The method of Claim 18 further comprising the step of creating an ultrasonic image from the digital ultrasonic signal.
- [c23] 23. The method of Claim 18 wherein the predetermined frequency comprises the sampling frequency rate multiplied by the first number of outputs.
- [c24] 24. The method of Claim 18 wherein the predetermined frequency and the sampling frequency rate are provided by a timing reference.